

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
4 November 2004 (04.11.2004)

PCT

(10) International Publication Number
WO 2004/095830 A3

(51) International Patent Classification⁷: **H01L 27/146,**
31/0352, 31/11

(21) International Application Number:
PCT/IL2004/000337

(22) International Filing Date: 20 April 2004 (20.04.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
155536 21 April 2003 (21.04.2003) IL

(71) Applicant (for all designated States except US): YISSUM
RESEARCH DEVELOPMENT COMPANY OF THE
HEBREW UNIVERSITY OF JERUSALEM [IL/IL];
Hi Tech Park, Edmond Safra Campus, Givat Ram, 91390
Jerusalem (IL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): SA'AR, Amir
[IL/IL]; 46 Hermon Street, 90805 Mevaseret Zion (IL).
SHAPPIR, Joseph [IL/IL]; 30 Hermon Street, 90805
Mevaseret Zion (IL).

(74) Agent: REINHOLD COHN AND PARTNERS; P.O.
BOX 4060, 61040 Tel Aviv (IL).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,
ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Euro-
pean (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,
GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

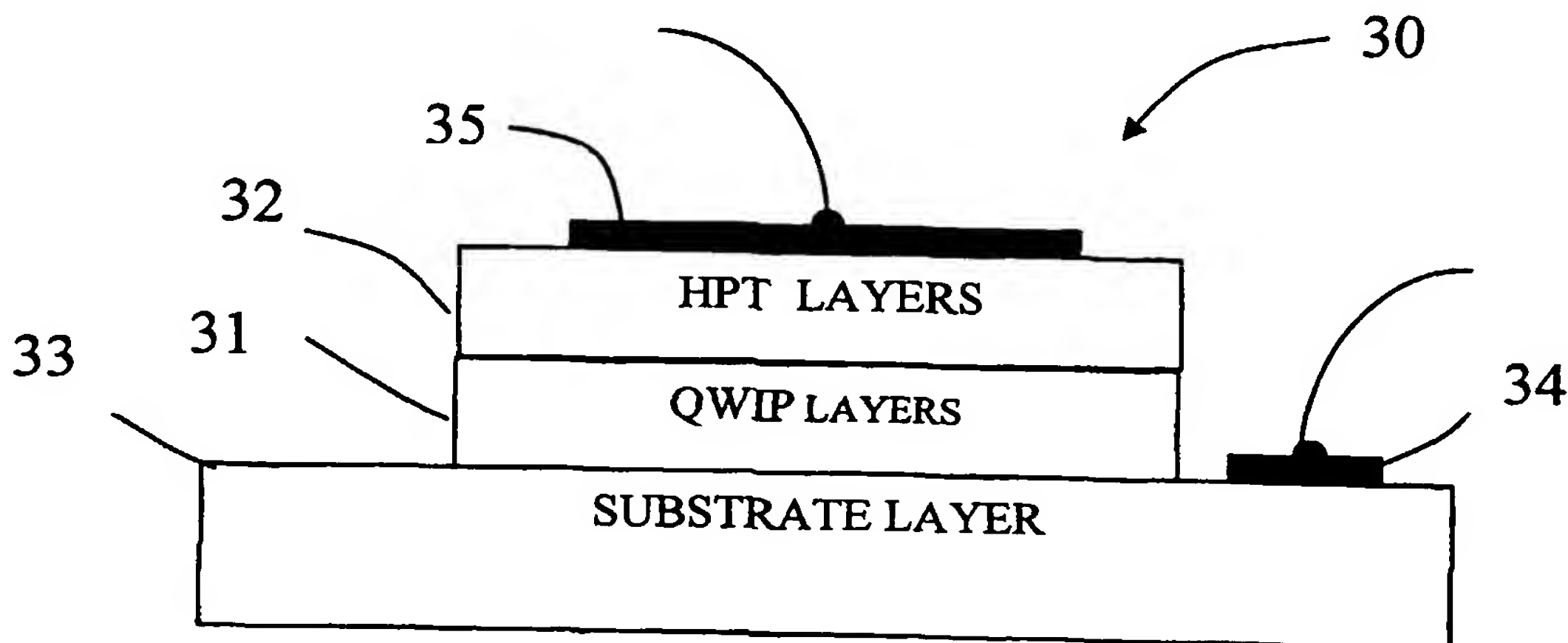
Published:

- with international search report
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

(88) Date of publication of the international search report:
16 December 2004

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: VOLTAGE TUNABLE INTEGRATED INFRARED IMAGER



(57) Abstract: An integrated thermal imager for detecting combined passive LWIR or MWIR radiation of a scene and active SWIR radiation of a laser source is described. The imager includes a two-dimensional focal plane array (2D-FPA) constituted by an assembly of voltage tunable photodetectors. Each voltage tunable photodetector integrates a quantum well infrared photodetector (QWIP) together with a heterojunction bipolar phototransistor (HBPT), thereby forming a pixel element in the 2D-FPA.

WO 2004/095830 A3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL2004/000337

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L27/146 H01L31/0352 H01L31/11

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97/17719 A (FRAUNHOFER GES FORSCHUNG ; SCHNEIDER HARALD (DE); SCHOENBEIN CLEMENS () 15 May 1997 (1997-05-15)	1-58
Y	figures 1,2 page 7, paragraph 1 - page 9, paragraph 3 page 11, paragraph 1 page 12, paragraph 3 ----- -/--	59,60

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

***L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)**

"O" document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

***T** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

'&' document member of the same patent family

Date of the actual completion of the international search

11 October 2004

Date of mailing of the international search report

21/10/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer _____

Visscher, E

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL2004/000337

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>COHEN N ET AL: "A monolithic LWIR/NIR multispectral QWIP for night vision and see spot"</p> <p>INFRARED PHYSICS & TECHNOLOGY ELSEVIER NETHERLANDS, vol. 42, no. 3-5, September 2001 (2001-09), pages 391-396, XP002299329 ISSN: 1350-4495 figure 1 page 524 - page 525</p>	59,60
X	<p>SCHNEIDER H ET AL: "VOLTAGE-TUNABLE TWO-COLOR DETECTION BY INTERBAND AND INTERSUBBAND TRANSITIONS IN A P-I-N-I-N STRUCTURE"</p> <p>APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 68, no. 13, 25 March 1996 (1996-03-25), pages 1832-1834, XP000582387 ISSN: 0003-6951 figures 1,2 page 1832, column 2, paragraph 2 - page 1833, column 2, paragraph 1 page 1834, column 1, paragraph 4</p>	1-58
X	<p>RYZHII V ET AL: "Device model of integrated QWIP-HBT-LED pixel for infrared focal plane arrays"</p> <p>ESSDERC 2002. PROCEEDINGS OF THE 32ND EUROPEAN SOLID-STATE DEVICE RESEARCH CONFERENCE UNIV. BOLOGNA BOLOGNA, ITALY, September 2002 (2002-09), pages 643-646, XP008036430 ISBN: 88-900847-8-2 figures 1,2 Section 1. Introduction</p>	1,31
A	<p>RYZHII V ET AL: "Analysis of dual-band quantum well photodetectors"</p> <p>JOURNAL OF APPLIED PHYSICS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 91, no. 9, 1 May 2002 (2002-05-01), pages 5887-5891, XP012056355 ISSN: 0021-8979 figure 1 Section I: Introduction Section II: Model page 5891, column 1</p>	1,31,59

-/--

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL2004/000337

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>LIU H C ET AL: "GaAs/AlGaAs quantum-well photodetector for visible and middle infrared dual-band detection"</p> <p>APPLIED PHYSICS LETTERS AIP USA, vol. 77, no. 16, 16 October 2000 (2000-10-16), pages 2437-2439, XP002299330</p> <p>ISSN: 0003-6951</p> <p>figures 1,2</p> <p>page 2437 - page 2438, column 2, paragraph 2</p> <p>-----</p>	1,31,59

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/IL2004/000337

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
WO 9717719	A	15-05-1997	DE	19538650 A1	24-04-1997
			CA	2232084 A1	15-05-1997
			WO	9717719 A2	15-05-1997
			DE	59610134 D1	20-03-2003
			EP	0856201 A2	05-08-1998
			US	6130466 A	10-10-2000